## REMARKS

Applicant appreciates the Examiner's thorough review of the present application, and respectfully requests reconsideration in light of the preceding amendments and the following remarks.

Claims 1-21 are pending in the application. Claim 1 has been amended to solely improve claim language, without otherwise touching the merits. More particularly, claim 1 has been amended to remove the wording "such as" which might be held indefinite. Original claims 1-9 remain substantively unchanged, notwithstanding the Examiner's art rejections manifested in paragraphs 1-4 of the Office Action. Claims 10-21 have been added to provide Applicant with the scope of protection to which he is believed entitled.

Original Fig. 1 uses reference numeral 12 to designate two elements. Fig. 1 has been corrected to fix this deficiency as shown in the concurrently filed Request for Approval of Drawing Corrections/Amendment.

The specification has been revised to provide appropriate headings and to be consistent with corrected Fig. 1.

No new matter has been introduced through the foregoing amendments.

The *35 U.S.C. 102(b)* rejection of claims 1-6 and 8-9 as being anticipated by *Lee* (U.S. Patent No. 5,715,983) is traversed because the reference fails to teach or disclose each and every element of the rejected claims.

As to independent claim 1, the *Lee* reference fails to teach or disclose a **barrel assembly mounted for axial movement within the housing**. *See* lines 4-5 of original claim 1. Element 33 of *Lee* that the Examiner alleges to be readable on the claimed barrel assembly is not mounted for axial movement within the housing. In contrast, element 33 is threadedly connected to housing 34. *See* Fig. 2 and column 2, lines 61-62 of *Lee*.

The *Lee* reference also fails to teach or disclose a **piston within the barrel assembly**. *See* line 3 of original claim 1. The piston depicted in the front part of Fig. 2 of *Lee* is not disposed

within the Examiner's "barrel" 33. Element 10 mounted within element 33 of *Lee* is actually a firing pin, rather than a piston. The Examiner is apparently mis-characterizing the *Lee* teachings.

Finally, *Lee* fails to teach or disclose **a resetting mechanism being powered in response to displacement of the mass on recoil**. *See* the last two lines of original claim 1. Elements 32 of *Lee* that the Examiner alleges to be readable on the claimed resetting mechanism is not being powered in response to displacement of the mass on recoil. In contrast, spring 32 of *Lee* is compressed during an opposite movement of elements 20 and 35, or the "mass" as applied by the Examiner, toward the front of the tool. *See* column 3, lines 19-21, and 33-37 of *Lee*.

Accordingly, Applicant respectfully submits that the *Lee* reference does not anticipate the invention of claim 1. *Lee*, alone or in view of the other applied reference, also fails to make the claimed invention obvious as the above highlighted limitations are not suggested by the applied references or knowledge generally available in the art. Thus, claim 1 is clearly patentable over the applied art of record. Claims 2-9 and new claims 10-13 depend from independent claim 1 and should be considered patentable at least for the same reason. The rejections of claims 1-9 are therefore erroneous and should be withdrawn.

The rejection of claims 2-7 is also erroneous and should be withdrawn because the applied references, especially *Lee*, fail to disclose, teach or suggest **means for engaging the piston** in a forward position in the barrel as recited in claim 2. Element 341 of *Lee* that the Examiner alleges to be readable on the claimed means for engaging the piston is not arranged to engage the actual piston (not numbered) or firing pin 10. Element 341 at best engages tubular seat 20 which the Examiner considers as the claimed mass. *See* Fig. 4 and column 3, lines 8-10 of *Lee*. Again, the Examiner is mis-characterizing the Lee teachings.

The rejection of claim 4 is also erroneous and should be withdrawn because the applied references, especially *Lee*, fail to disclose, teach or suggest that the **recoil mass is propelled forwardly** by a strong resilient bias, as recited in claim 4. In *Lee*, "mass" 20-35 is not propelled forwardly by a strong resilient bias. Rather, the *Lee* "mass" is pushed forward (e.g., manually) by rod 36. *See* column 3, lines 19-21 of *Lee*.

The rejection of claim 7 is also erroneous and should be withdrawn because the Examiner's suggestion or motivation to combine *Lee* with the teaching reference of *Jochum* (U.S. Patent No. 5,538,172) is inadequate. The Examiner's so-called motivation to combine fails to adequately specify why a person of ordinary skill in the art would have been motivated to substitute the *Jochum* piston braking assembly for the *Lee* element 341 that is used for a completely different purpose of forming a dead stop for tubular seat 20. Applicant respectfully submits that *Lee* and *Jochum* are not properly combinable in the manner proposed by the Examiner.

The rejection of claim 9 is also erroneous and should be withdrawn because the applied references, especially *Lee*, fail to disclose, teach or suggest piston retention means comprising pads adapted to **frictionally engage** the piston, as recited in claim 9. In *Lee*, element 13 is not adapted to adapted to frictionally engage firing pin 10, which the Examiner apparently considers to be readable on the claimed piston. *See* Fig. 1 of *Lee*.

As to claim 10, the applied art of record, especially *Lee*, fails to disclose, teach or suggest that the barrel assembly is **disconnected** from the mass and has rear surface adapted to strike on a front surface of the mass to drive the mass rearwardly on recoil, as presently claimed. Note elements 20 and 35 of *Lee* that are threadedly connected.

As to claim 11, the applied art of record, especially *Lee*, fails to disclose, teach or suggest that the barrel assembly is mounted axially movable relative to said housing between a forward position and a rearward position, and, in the forward position, a front section of **the barrel assembly projects outside the housing**. Note element 20 of *Lee* that does not project beyond face 311.

As to claim 12, the applied art of record, especially *Lee*, fails to disclose, teach or suggest that firing of said tool is enabled only if the front section of the barrel assembly is completely retracted within the housing.

As to claim 13, the applied art of record, especially *Lee*, fails to disclose, teach or suggest that **the piston is completely kept within the barrel assembly** during operation of said tool. Note that firing pin 10 of *Lee* must project beyond face 311 to ignite explosive charges.

As to claims 14-21, the applied art of record, especially *Lee*, fails to disclose, teach or suggest an explosively operated tool for driving a fastener into a substrate, said tool comprising: a housing; a barrel mounted to the housing for axial movement relative to the housing between first forward position and first rearward position; a piston axially displaceable within the barrel between a second forward position and a second rearward position, said piston being explosively driven forwardly from the second rearward position to the second forward position, causing a recoil movement of said barrel from the first forward position to the first rearward position; and a resetting mechanism connecting the barrel and the piston for automatically resetting the piston from the second forward position to the second rear position in response to a return movement of the barrel from the first rearward position to the first forward position. Note that claim 14 requires **opposite movements** of the piston and the barrel during resetting the tool. This is not taught nor suggested by the applied art of record, especially *Lee*.

As to claim 15, the applied art of record, especially *Lee*, fails to disclose, teach or suggest that axial distance between the first forward position and the first rearward position is **shorter** than that between the second forward position to the second rear position. In other words, the piston and barrel travel **different distances** on resetting. This is not taught nor suggested by the applied art of record, especially *Lee*.

Each of the Examiner's rejections has been traversed. Accordingly, Applicant respectfully submits that all claims are now in condition for allowance. Early and favorable indication of allowance is courteously solicited.

The Examiner is invited to telephone the undersigned, Applicant's attorney of record, to facilitate advancement of the present application.

Respectfully submitted,

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MARKED-UP VERSION SHOWING CHANGES

# POWER ACTUATED TOOLS

Field

The present invention relates to power actuated tools and more particularly to explosively actuated tools for driving a fastener such as a pin into a substrate such as concrete or steel.

Background

Explosively actuated tools for driving a fastener such as a pin into a substrate such as concrete or steel conventionally comprise a driving piston which is driven forwardly along the barrel of the tool upon detonation of an explosive charge to drive into the substrate a fastener within the forward end of the barrel. After the firing stroke has been completed, the driving piston is within the forward end of the barrel and appropriate action must be taken to reset the piston into a rear position within the barrel in preparation for the next driving stroke. This may be achieved by a manual action by the operator. One method of manually resetting the piston and which is widely used in practice involves the operator drawing the barrel forwardly from the housing of the tool while the piston is restrained so that the piston lies within a rear part of the barrel which is then retracted manually back into the housing.

There have been proposals for automatic or semi-automatic resetting of the piston. One such proposal involves the use of the explosive gas generated on firing the tool to drive the piston back into its rear position within the barrel after firing. Such a system can however lead to safety problems as the ducting of the explosive gas to a piston return mechanism can result in accumulation of unburnt explosive powder within the mechanism. Further, the problem arising from unburnt residues may be compounded if the tool is not used shortly after resetting of the piston and is subject to rough handling or vibration, for example by being transported on the floor of a truck, whereby the previously reset piston can move out of its predetermined rear position thereby leading to loss of power and possible generation of increasing amounts of unburnt residue at the next firing action.

Alternative proposals for an automatic piston return mechanism involve the use of spring energy which is stored during the driving stroke of the piston and is then released at the end of that stroke to return the piston to its rear position within the barrel. This system

however suffers from the disadvantage that part of the driving force of the piston is used to provide the energy for return or resetting of the piston whereby the effective power of the tool is reduced.

In a conventional explosively actuated tool of the type under consideration, firing of the tool generates a recoil effect similar to that experienced upon discharge of a firearm such as a pistol of rifle and this recoil effect can be quite tiring to the operator of the tool.

Summary

The present invention seeks to provide a tool in which the recoil effect is, at least to a significant extent, absorbed within the tool without passing directly to the hands of an operator holding the tool, with the recoil energy being used to power a system for resetting the piston.

According to the present invention, there is provided an explosively operated tool for driving a fastener into a substrate such as steel or concrete, said tool comprising a housing, a barrel assembly mounted within the housing, and a piston within the barrel assembly and actuated upon firing of the tool to drive a fastener in the forward end of the barrel assembly into a substrate, wherein the barrel assembly is mounted for axial movement within the housing and co-operates with a mass mounted for rearwards movement relative to the housing in opposition to a biasing force to absorb recoil on firing of the tool, and a resetting mechanism for resetting the piston into a rear part of the barrel assembly after firing, said resetting mechanism being powered in response to displacement of said mass on recoil.

In a preferred embodiment the resetting mechanism comprises means for engaging the piston in a forward position in the barrel, and means for displacing the engagement means rearwardly to thrust the piston rearwardly, said displacement means comprising an energy source in which energy is stored as a result of displacement of the recoil mass upon recoil.

In a preferred embodiment the energy source comprises a spring in which potential energy is stored in response to displacement of the recoil mass, said potential energy

suddenly being released to cause the piston to be propelled rearwardly. The spring may be a coil spring, an elastomeric spring, or a gas spring.

In a particularly preferred embodiment, the recoil mass is propelled rearwardly against a strong resilient bias to absorb the recoil force and is then propelled forwardly by that bias, the spring associated with the resetting mechanism being charged with potential energy in response to the forwards movement of the recoil mass.

Preferably, the engagement means comprises means for gripping the piston at its forward end portion when in its forward position within the barrel assembly. Preferably, the gripping means is interposed between forward and rear barrel sections of the barrel assembly, said forward and rear barrel sections preferably being separate barrel sections.

Preferably, piston retention means are provided to retain the piston in its rearmost position after resetting, said retention means acting in response to rebound of the piston from its rearmost position as a result of the sudden thrust used to effect resetting.

Brief Descn →

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a schematic longitudinal section of a tool in accordance with a preferred embodiment of the invention, the tool being shown in an at rest position after completion of a firing stroke in which a fastener has been driven into the substrate and the driving piston of the tool has been reset into a rear position within the barrel assembly, the configuration of Figure 1 being immediately prior to cocking of the tool;

Figure 2 is a section similar to Figure 1 but showing the configuration when the tool is cocked by pressing the forward end of the barrel assembly against a substrate preparatory to firing;

Figure 3 is a section similar to Figure 1 but showing the configuration immediately after firing in which the piston is in the forward end of the barrel assembly and a recoil mass is in its rear position relative to the housing of the tool;

Figure 4 is a section similar to Figure 1 but showing the configuration shortly after that of Figure 3 in which the recoil mass and barrel assembly have returned to a forward position; and

Figure 5 is a section similar to Figure but showing the configuration shortly after that of Figure 4 in which resetting of the piston has commenced.

Detailed Description

As shown in the accompanying drawings an explosively actuated tool for driving a fastener such as a pin into a substrate such as concrete or steel, comprises a main multi-part housing 2 having a handle 4 with a trigger 6 which co-operates with a firing mechanism in conventional manner. A barrel 8 mounted within the housing 2 carries a drive piston 10 which is propelled forwardly along the barrel 8 upon firing of an explosive charge so as to drive into the substrate a fastener within the forward end of the barrel 8. The rear end of the barrel 8 co-operates in conventional manner with a strip ~~12~~ 120 containing a number of explosive charges arranged seriatim along the strip. The barrel 8 comprises a front section 8a which projects forwardly from the housing and a separate rear section 8b. The front and rear barrel sections 8a, 8b are each mounted for axial movement relative to the housing 2 and the two barrel sections 8a, 8b are separated by a piston retention and resetting mechanism 12 which is also mounted for axial movement within the housing 2. The mechanism 12 has a central passage aligned with the bore of the front and rear barrel sections 8a, 8b whereby the piston 10 can extend from the rear barrel section 8b into the front barrel section 8a via the mechanism 12.

The barrel 8 is subjected to a spring bias which causes the forward end of the barrel to project forwardly of the housing 2 as shown in Figure 1. Cocking of the tool to enable firing requires the forward end of the barrel 8 to be pressed against the substrate so that the barrel is retracted into the housing 2 against the spring bias. This is a safety feature which is conventional in explosively actuated tools of this type to ensure that firing can only take place when the forward end of the barrel is pressed firmly against the substrate. This condition is illustrated in Figure 2. In its rearmost position as shown in Figure 2, the rear end of the barrel 8 co-operates with a breach block assembly 14 which includes the firing pin 16 and other components of the firing mechanism. In a conventional explosively

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. An explosively operated tool for driving a fastener into a substrate such as steel or concrete, said tool comprising a housing, a barrel assembly mounted within the housing, and a piston within the barrel assembly and actuated upon firing of the tool to drive a fastener in the forward end of the barrel assembly into a substrate, wherein the barrel assembly is mounted for axial movement within the housing and co-operates with a mass mounted for rearwards movement relative to the housing in opposition to a biasing force to absorb recoil on firing of the tool, and a resetting mechanism for resetting the piston into a rear part of the barrel assembly after firing, said resetting mechanism being powered in response to displacement of said mass on recoil.

2. A tool according to claim 1, wherein the resetting mechanism comprises means for engaging the piston in a forward position in the barrel, and means for displacing the engagement means rearwardly to thrust the piston rearwardly, said displacement means comprising an energy source in which energy is stored as a result of displacement of the recoil mass upon recoil.

3. A tool according to claim 2, wherein the energy source comprises a spring in which potential energy is stored in response to displacement of the recoil mass, said potential energy suddenly being released to cause the piston to be propelled rearwardly.

4. A tool according to claim 3, wherein the recoil mass is propelled rearwardly against a strong resilient bias to absorb the recoil force and is then propelled forwardly by that bias, the spring associated with the resetting mechanism being charged with potential energy in response to the forwards movement of the recoil mass.

5. A tool according to any one of claims 2 to 4, wherein the engagement means comprises means for gripping the piston at its forward end portion when in its forward position within the barrel assembly.